all together

issue 06 / june

2019

news edition

TEMAK®

TOTAL WATER SOLUTIONS

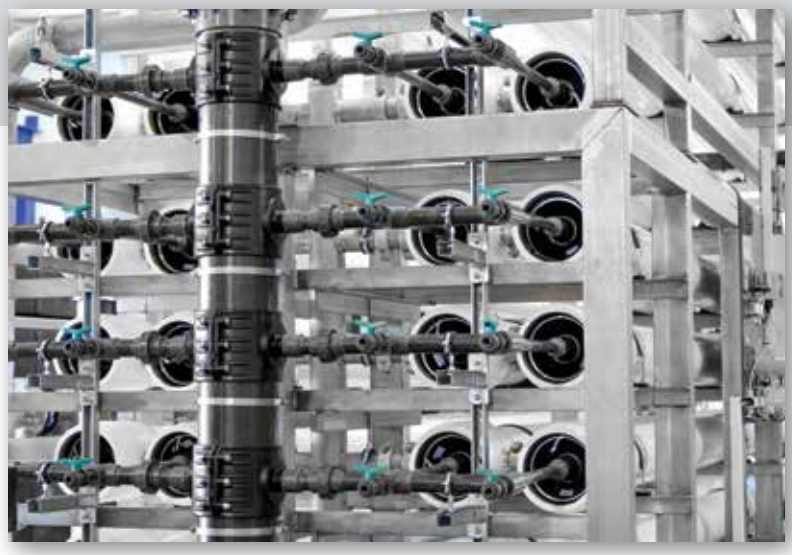
www.temak.gr

Desalination unit in Argostoli, Kefalonia

Desalination unit in a 5-star hotel, Egypt

Water systems maintenance

contents



TEMAK®
TOTAL WATER SOLUTIONS

62 Tatoiou Str, 136 77, Athens, Greece
Tel.: +30 210 2581583, fax: +30 210 2533989
e-mail: info@temak.gr | www.temak.gr

Water
Should we take it for granted?

Herodes Mitsopoulos
Chairman of Board

Water, along with air and sun, is the key factor in life.

The human body is made up of 70% of water and it can survive only a few days without it.

Therefore, water and in particular **drinking water** is absolutely necessary for the present and the future of mankind.

It is broadly known that ¾ of the surface of the earth is covered by water (seas, rivers, frosts, etc.) and amounts to about 1400 million cubic meters.

Out of these, only 0.03% (420.000 cubic kilometers) is directly exploitable surface water (lakes and rivers). The rest is sea, frost and underground waters.

In these 0.03% of directly exploitable water, only a few areas are accessible on the planet. While the rest either do not have water, or have little or infected.

Therefore, in many regions of earth, in Greek islands and in the regions of mainland Greece, there is a strong demand of available water of good quality.

The solution to this request is given by applying water technology methods and processes (desalination, filtration, etc.) to available water (seawater, lakes, rivers and groundwater). The product water can be used for every need (drinking, irrigation, industry, etc.

This is exactly our job at TEMAK:
We take advantage of the abundant water of nature and provide the required water of excellent quality.

Argostoli, Kefallonia: Desalination Unit providing drinking water to the municipality

PROJECT
Desalination system with capacity of 10.000 m^3/day of drinking water

LOCATION
Argostoli, Kefalonia, Greece

DATE OF IMPLEMENTATION
March 2019

PROJECT DESCRIPTION
The failure of the citizens of Argostoli to enjoy drinking water from their fountains belongs to the

past thanks to decisive and valuable contribution The biggest and most modern desalination unit producing drinking water in Greece of TEMAK to the implementation of the project.
In March of 2019, TEMAK, in collaboration with the contractor, successfully delivered the largest and most modern brackish water desalination system in Greece with capacity of 10.000 m^3 drinking water per day.
It is a modern potable water production system based on Reverse Osmosis process. In addition to that, it is the third desalination system operating on the island.

« The biggest and most modern desalination unit producing drinking water in Greece »

It is noted that TEMAK also contributed to one of the largest development projects on the island in the last decade by installing 2 desalination units in 2011 in Fiskardo, producing 700 m^3 per day drinking water from sea water.

PROBLEMS AND CHALLENGES

Poor water quality, estimated to present chlorinated concentration (Cl^-) which is five times more than the acceptable international limits (250 mg/L). Difficult access and transportation of equipment on the island, as well as local conditions, were the main issues that had to be tackled by TEMAK.
The company's rules on the use of certified raw materials, in combination with the exploration of new innovative solutions led to the completion of a unique project in Greece, providing safe, clean and potable water to citizens of Kefalonia.

RESULT

The Desalination Unit of brackish water in Argostoli, Kefalonia, is not only a model solution of processing brackish water as it provides drinking water to the Municipality of TEMAK but also can become the springboard for the construction of new water production plants all over Greece.

Kos: Reverse osmosis unit processing brackish water to produce potable water in 5-star hotel

CLIENT
A hotel group with hotel units in Kos, Andalusia, Halkidiki and Dassia, Corfu entrusted TEMAK to install Reverse Osmosis Unit in new 5-star hotel in Kos, with capacity of 370 suites and rooms. In 2018, a hotel of the same group in Corfu installed a Reverse Osmosis Unit processing brackish water and producing 610 m^3 per day.

LOCATION
Kos

DATE OF IMPLEMENTATION
April 2019

PROJECT DESCRIPTION
In 2019, the installation and start-up of a reverse osmosis production plant of 700 m^3 per day was successfully completed in a 5-star hotel in Kos.

PROBLEMS AND CHALLENGES
The hotel used drilling water containing difficult to process elements like arsenic and lead. With the aim of providing excellent water quality and securing the water sterilization in the following years, we studied the design and construction of a specialized system perfectly adapted to the specific needs of the particular hotel.
Simultaneous work in the hotel environment made it difficult for the engine room to be accessed and travelled as all the equipment had been transferred to the site with the help of a special telescopic loader.

RESULT
The desired delivery time for the system in full operation was limited, since the system had to be installed much earlier since the start of the hotel.
Thanks to experience and know-how of the TEMAK team combined with the training of the specialized technician who has undertaken the start-up as well as the complete regulation of the system, the reverse osmosis unit delivered in due time.
The hotel has covered all its needs in top quality drinking water and has many benefits at many levels from its use with an operating cost per cubic meter produced water below 0.3 m^3 /h.

Industry: Reverse osmosis systems with production 200 m³/day

CLIENT
A leading Greek industry, specialized in packaging sector, entrusted TEMAK with the third water treatment system of 200 m³ per day. The two companies keep long-term cooperation and the industry, apart from the desalination systems, is supplied by TEMAK with chemicals and full network equipment.

LOCATION
Atalanti

DATE OF IMPLEMENTATION
January 2019

PROJECT DESCRIPTION
At the beginning of 2019 and in less than two months from the signing of the agreement, the installation and the delivery of a full-scale brackish water desalination systems was completed, meeting the increased needs of the industry in desalinated water at the entrance of the boilers.

PROBLEMS AND CHALLENGES
The needs of the plant increased due to the expansion of its production line. The people of the plant, in cooperation with TEMAK team, realized very quickly that a new solution had to be found, with the result that the planning and implementation of the necessary projects to support the production of the plant were made immediately. The equipment had to be placed in the existing plant site within a short time, which was quite limited as there were already two reverse osmosis systems installed with pretreatment and old steam boilers. With exemplary cooperation the two teams removed old stream boilers from their place and created the necessary space for the installation of new systems and necessary piping.

RESULT
The new desalination unit was symmetrically positioned with the other two existing (TEMAK), achieving the optimal technical, visual and quality results, increasing the total daily production of desalinated water to 600 m³/day.
Thanks to the mutual trust between the two companies and their multiannual cooperation, the shortest possible time to complete the project was achieved.

Cruise ship: Special construction of desalination system with total production of 300 m³/day

CLIENT

The cruise ship in which the desalination system was installed belongs to one of the most important groups in the Israeli economy, operating in the shipping, leisure and holiday sectors, real estate, technology and communication.

DATE OF IMPLEMENTATION

December 2018

PROJECT DESCRIPTION

During the reconstruction of a cruise ship recently acquired by the Israel group, two autonomous desalination plants producing 150 m³ per day (total production of 300 m³ per day) were installed with energy recovery systems, providing water for general uses of the ship.

PROBLEMS AND CHALLENGES

TEMAK was assigned with the project and had to deal with many issues. Such as:

- The autonomous operation of the units.
- Limited space for installation.
- The narrow passages of the ship from which the equipment had to travel along to the final installation site.
- Promoting the differentiation of the proposed technical solution from that used by domestic and international competitors to the client.

TEMAK has responded successfully to challenges by

implementing specialized technical solutions such as:

- Making a special pioneering design of 2 units in a single frame.
- Selection of appropriate equipment (membranes, turbidity filters etc.) for access from all passages of the ship.
- Construction of a sliding frame. The system arrived on the ship disassembled an reassembled at the site.
- Designing of systems with energy recovery devices saving 40% energy, achieving less operation and strain on the ship's electromechanics, which leads to significant sav

RESULT

The customer entrusted TEMAK with its proposed innovative solution for water treatment, despite the fact that the application of this technology is not customary in the shipping industry.
The advantages of the solution are many in the long run, as energy savings are achieved resulting in fuel savings bringing it as distant saving significant financial resources.

Egypt: Desalination system of sea water with capacity of 1000 m³/day in multi-national association

CLIENT
5-star hotel of multi-national group

LOCATION
Egypt

DATE OF IMPLEMENTATION
April 2019

PROJECT DESCRIPTION
In a 5-star hotel in Egypt, in April 2019, a sea water desalination system of 43.000ppm, put on operation, with a capacity of 1.000m3/day, so as to meet the drinking needs of hundreds of customers.

PROBLEMS AND CHALLENGES
TEMAK undertook to adapt and place the complete solution to the hotel in a prefabricated area of the client, to cooperate and train new people in a week.

Sea water is stored in a tank and through a feed pump is forwarded to turbidity filters to remove particles. Dilution is carried out with Antiscalant to protect the reverse osmosis membranes. Then, the water enters in the reverse osmosis system producing 42.6 m³/h of desalinated water with 42% recovery.

The system is equipped with an energy recovery device for maximum energy savings and with CIP system for rinsing the membranes to carry out

«Drinking water from desalination to the largest chain of hotels of Middle East»

chemical cleaning when necessary. The caustic soda is dosed in the water to adjust the pH and the water is collected in the water tank, where it is chlorinated before it is sent to consumption. The design temperatures range is 17-27°C (annual sea water temperature variation in Alexandria).

Reverse Osmosis System double pass with hot disinfection system

Hot disinfection of
reverse osmosis systems & water recirculation loop equipment

Hot disinfection is called the process in which hot water (around 80°C) circulates in reverse osmosis system and loop equipment to keep the whole equipment and network almost sterile from microbial load.

Reverse osmosis application enhanced by hot disinfection are made in:

- Kidney dialysis units
- Pharmaceuticals
- Food industry

These applications do not allow the dosing of chemicals during water treatment, such as the use of sodium hypochlorite, resulting in a higher risk of developing microorganisms, and the acceptable microbiological parameter limits are too low.

An example is the internationally accepted standard EC Pharmacopoeia "Water for diluting concentrated hemodialysis solutions" for water intended for use in hemodialysis machines which provides for the absence of E.coli, coliforms, pseudomonas etc. with a limit to endotoxins <0.25 IU/ml and aerobic micro-organisms <100 cfu/ml. For pharmaceuticals, the total number of bacteria in parified water should be <100 cfu/ml, while in water-producing application for injecting drugs <10cfu/ml.

From the above, the significance of periodic disinfection is clear.

Disinfection methods

Disinfection of the membranes is carried out either by the use of strong oxidizing chemicals such as hydrogen peroxide and peracetic acid in concertation compatible with the membranes (- 0.2% w/w) or by hot disinfection carried out with hot water at 80°C. Chlorine is not allowed as the membranes are destroyed by free chlorine.

Benefits of disinfecting membranes by hot water

The advantages of water disinfection against chemical use are as follows:

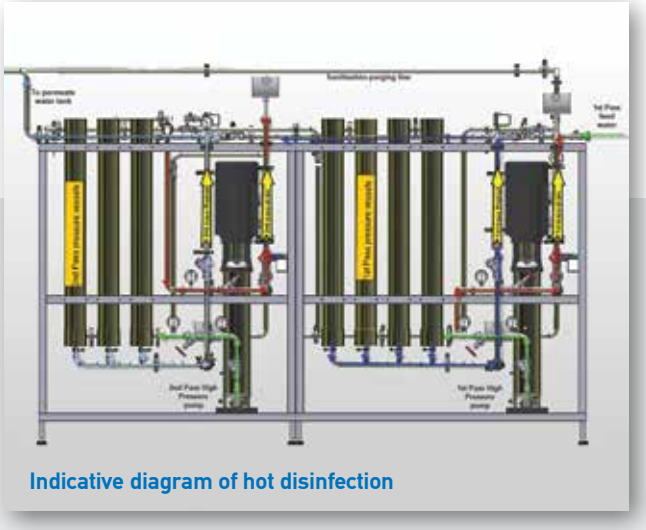
- Avoid using chemicals.
- Avoid chemical waste management.
- There is no need to authorize the use and storage of chemicals.
- The process of disinfection is simpler.
- Greater efficiency in comparison with the use of chemicals, as heat can reach parts of the facility that chemicals do not reach (DOW FILMTEC Heat Sanitization).
- The process of thermal disinfection is much easier and safe process for use as no strong oxidation chemicals are required and hot water production is automatic. As a result, the procedure may be more frequent.
- Easy control of heat in comparison with chemical concentration, resulting in ease of confirmation and minimization of errors (DOW FILMTEC Heat Sanitization).
- Longer membrane lifetime and consistent performance in terms of water quality for more disinfection cycles

> «Heat can reach parts of the facility that chemicals do not reach.»

Benefits of hot disinfection of water recirculating loop equipment

In water treatment systems for hemodialysis machines or for drug production, the non-consumed water which is produced is recycled continuously. In this recirculation loop hot disinfection takes place.

In addition to the advantages of the hot disinfection against it with chemicals mentioned above for the membranes, we mention that in the water recirculating loop of the dialysis systems, disinfection is carried out with a very high concentration of free chlorine at concertation of 100 ppm. Successive rinsing of the loop is required until the concentration of free chlorines becomes zero.



Indicative diagram of hot disinfection

Special features of reverse osmosis systems with hot disinfection:

- Membrane compartments, reverse osmosis tubing, hot disinfection tank and hot disinfection tubing are made of stainless steel (sanitary type). Stainless steel has a Ra of 0.8 micron and the joints have tri-clamp-like ends, ensuring the smooth surface and avoiding trapping of microbes in the connection, thus minimizing the possibility of microbial load growth. At the same time, triclamp connections minimize the risk of leakage.
- The high pressure pump is multi-level, made from stainless steel with tri-clamp end (hygienic type).
- The membranes used in hot disinfection systems are not conventional, but are suitable for high temperature disinfection up to 85°C and full fit (no spaces are left in the chiller so as not to create spots with standing water.
- The tank used for hot disinfection is stainless, with roughness factor Ra<0,8 micron, with special thermal insulation to protect the user and to reduce losses.
- The membranes, the reverse osmosis tubing system, the hot disinfection tank and tubing systems are made of 316L stainless steel (sanitary type). It has a sprinkler system that sprays the entire inner surface of the tank by reducing the possibility of microbial growth.
- The recirculation pump is stainless with tri-clamp ends (hygienic type).
- In the case of steam network, the tank is constructed so that it is steam-heated. Otherwise, the tank has a suitable electrical resistance to heat the water to the desired temperature.

«The membranes, the reverse osmosis tubing system, the hot disinfection tank and tubing system are made of stainless steel 316L (sanitary type).»

Tank filling system with tubing systems and Fittings from stainless steel 316L (sanitary type) with tri-clamp ends and roughness Ra<0,8micron

Shipping Industry:

The international trend regarding disposable plastic on board favors the installation of reverse osmosis systems

Much conversation has been made regarding new technologies and their application in the marine industry. Evolution has been leaping forward over the last few years and when this is combined with the new legislations from maritime organizations the decision making is specified both as compulsory and difficult.

Over this presentation we will examine the new technologies available for fresh water production aboard a marine vessel, their advantages, and their true usefulness.

Στα For the latter part of the last century and up to the beginning of the new millennia, production of the fresh water has been performed by the method of evaporation, using the old classic Fresh Water Generators (FWG), which is one of the important machinery on board a ship and is something that cannot be done without. Fresh water produced from fresh water generator is used for drinking, cooking, washing and even running other important machinery which use fresh water as a cooling medium. These systems proved their worthiness through the passage of the years but presented their major drawbacks at the same time.

- In order to perform evaporation, main engine operation is needed, thus the cost of the produced water is burdened by fuel cost. (especially difficult

during anchorage)
- Water produced, under nominal conditions, is only of 1 quality, technical or distilled, which is perfect for engine deck applications but inadequate for any other use.
- These systems (depending on their design and type) are prone to faults mainly by incorrect user control.
- Upon cleaning or overhauling FWG, the man hours needed are many and spare parts required, are often quite expensive.
- FWG's most often problem is that the distillate water produced is too salty (scale formations, wrong setup of apparatus, wrong gaskets, incorrect quantity of water intake, etc)

These drawbacks, plus the need for water that fits the requirements for alternate uses commanded thinking outside of the box. Distilled water is ideal for use as a cooling medium, but is quite aggressive in metals when used for deck cleaning (leading to electrolysis and rust) and completely inappropriate when used for human consumption, considering the fact that is very difficult to "reverse engineer" it back to a quality that qualifies as drinking water.

All of the above lead to the need for an alternative solution for water production in the marine industry; hence the reverse osmosis systems are gradually gaining ground.
Water producing via reverse osmosis systems besides providing solutions to all of the drawbacks of the FWG mentioned above, has many advantages:

- R/O systems energy requirements are low, and can operate without the need of the main engine.
- R/O systems are compact, and space requirements are less than with other desalting systems, e.g. distillation.
- R/O equipment is standardized - pumps, motors, valves, flowmeters, pressure gages, etc. Thus, the learning curve for unskilled labour is short.
- R/O systems are fully automated and designed to start-up and shutdown automatically through interlocks. Thus, RO plants usually require little labour.
- Due to their modular design, maintenance is easy.
- The modular design also makes expansion-upgrade an easy option.

The benefits granted by reverse osmosis systems onboard a vessel are numerous and can be categorized as direct and indirect. Direct can be named
- the lowered cost of the produced water
- the guaranteed quality of the produced water
- the possibility of more than one streams of produced water as per quality (technical, drinking)
- Standardized and low operational cost
- Standardized and low consumables cost.

Whereas the indirect benefits are:
- Low learning curve
- No man hours needed for operation or service.
- The capability of producing water for "general uses", thus a less aggressive stream which in turn is "friendlier" towards piping and metals on deck.

One last but quite important factor regarding the water producing in the marine industry is the new legislation promoted by IMO. A call has been made for the International Maritime Organization to regulate against the use of single-use plastic bottles onboard.

«Ο Captain Naveen Singhal from Singapore-based JAG Consultants has highlighted the issue in articles submitted for in-house magazines published recently by the Singapore Shipping Association, the Nautical Institute and ship-manager Anglo-Eastern.

Singhal has argued for a regulation to curb single-use plastic bottles at the "generation stage" –the procurement and consumption of water in plastic bottles. Guidance and control measures on potable water, tanks, piping, purification, testing and dispensing would make this a robust process that would be in the interest of seafarers' health, their well-being, and that of the environment as well, Singhal has suggested.

Ship-owners are obliged to provide clean potable water, under the Maritime Labour Convention. Singhal believes most owners would gladly adopt his suggested changes to reduce the financial burden of purchasing and disposing of plastic bottles. The consumption and disposal of water from plastic bottles costs an owner around $14,000 a year per ship, according to JAG Consultants analysis..

The weight of an empty bottle is about 12.7 g. assuming a modest consumption of 24 bottles of water on a vessel per day; Singhal has worked out that the plastic bottle waste generated by one merchant ship would be 305 g per day or 110 kg per ship per year. The estimated 50,000 SOLAS ships worldwide would therefore be responsible for 5,500 tons of plastic bottle waste a year.

"If we assume that just 5% of these water bottles are disposed of overboard, either intentionally or inadvertently, in contravention of MARPOL Annex 5, ships will be contributing 395 metric tons of plastic to the oceans every year," Singhal wrote in a widely republished article.

With seafarer strength of about 25 on each cargo vessel, a company is likely to spend roughly $10,000 per ship per year on bottled water, according to JAG Consultants, and another $4,000 per ship per year to dispose of the empty bottles.
"In the next few years the cost of disposal is certain to rise sharply as more countries implement strict anti-plastic regimes," Singhal warned.
Many shipping companies are moving away from plastic drinking bottles onboard.
For instance, an ongoing campaign at Anglo-Eastern highlighting the health and environmental hazards posed by single-use plastic is edging the group closer to the goal of a plastic-free ship.

Japanese ship-owner NYK meanwhile has installed reverse osmosis systems and special filters for drinking water onboard all its ships. Members of ship staff consume filtered water from designated drinking water tanks.

According to a BBC report, about 8m tones of plastic enter the oceans each year. If deposition continues rising at current rates, the annual total could reach 17.5m tones by 2025.

Figures from the International Bottled Water Association show that only 23.4% of plastic bottles are recycled[1].

Source 1: https://splash247.com/call-for-imo-to-ban-single-use-plastic-bottles-at-sea/

The value of timely maintenance of water treatment system.

The desalination unit is an electromechanicalsystem that requires supervision and surveillance for its proper and orderly functioning. Most parts are stressed for a variety of reasons, such as metal parts coming in contact with high salinity water, membranes that reject all dissolved and contained ions, automation and special instruments which control the system functions and the quality of the water produced.

Therefore, the prevention and consistent maintenance of a desalination plant are two important factors contributing to the long-term supply of top quality water at a constant rate and with minimal operating costs.

Benefits of preventive maintenance of equipment

- The possibility of extraordinary damage and consequently the cost of desalinated water is reduced.
- Maximizing process efficiency and reliable operation of the main parts of the system (pumps, filters, membranes).
- Less stress on the equipment is avoided, salt and contamination are avoided and the aging time of the filters and membranes is reduced.
- The constant quality of drinking water is ensured.

It is noted that the ideal period for the preventive maintenance of water treatment systems in seasonal business units and all kind of tourist accommodation is before the beginning of the season.

Maintenance of desalination unit reverse osmosis membranes

The membrane of reverse osmosis is the «Heart» of the system and is responsible for separating the water into two streams, namely the stream of good

water quality and that of the water that is rejected.

Even in systems that operate with good quality inlet water, the aging factor is inevitable, so the maintenance of the equipment is considered necessary. Failure to observe the periodic cleaning of the membranes leads to high operating systems pressures, resulting in increased power consumption. In addition, the amount of water produced is reduced and the water quality is reduced too. An average membrane change time in a typical reverse osmosis system varies between 3-5 years depending on the application.

Prevention is the only ally to the effect of aging and the prolongation of the life of the equipment. A fairly efficient and widespread method is chemical cleaning. Special chemical solutions, acidic and alkaline, are recirculated in the hydraulic system of the system and pass through the membranes by removing contaminants that are deposited during operation.

All TEMAK systems are designed in such a way that a chemical system can be easily and directly connected.

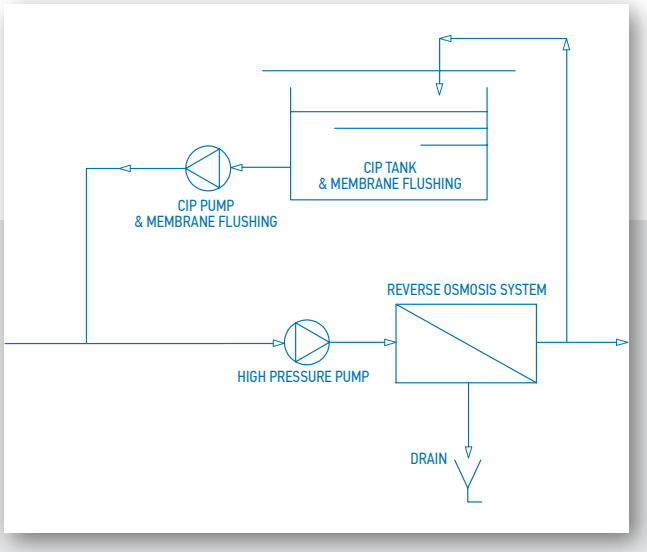
Equally important is the periodic checking of the correct operation of the pretreatment filters. Pretreatment filters hold suspended materials and organic load before the water which is to be treated enters the membranes of the system. There are few examples of the complete destruction of membrane systems of suspended materials or chlorine which have not been retained because of the poor maintenance of turbidity or carbon activated filters.

Advantages of cooperation with TEMAK for the supply of water treatment systems.

- Experience and expertise.
- High quality products and services.
- Comprehensive and fully modernized.
- Certification and operation with procedures.
- Cross-application time to a multitude of statisfied customers.
- Provide technical support by trained technical staff with application specific expertise.
- Availability of spare parts.

«Proper and responsible maintenance of a system creates a relationship of trust «Consistency and continuity» between the customer and TEMAK.»

- Maintaining the historicity of the operation of a system, which is an important factor for either the TEMAK staff or the customer's maintainer to know how to intervene immediately and quickly in the case.
- Immediate response to all customer requests.



Municipality of Hydra: Drinking water with the lowest production cost in Greece

The start-up of the TEMAK desalination unit, which supplies Hydra with drinking water, took place in August 2014. With a capacity of 1,600 cubic meters of water per day, it remains the only desalination project in Greece that produces drinking water of excellent quality with cost only 1.19 €/m^3, which is the lowest price in Greece until today.

The precious water of desalination, which flows to the fountain of every Hydrate, is not only a source of life, as the daily habits of the citizens have been facilitated and the island has literally «flourish», but also a pillar of growth and prosperity.

Previously, Hydra supplied water with aqui-

The Gold Best City Awards 2018, which concerns the «Water Resources Management - Desalination» category, is a culmination of TEMAK's long-standing experience in implementation of integrated solutions for the desalination of brackish and seawater, supporting the effort made by municipalities and local authorities to ensure excellent quality of water, available for drinking purpose.

fers throughout the year. The water, although non-drinking and of poor quality, cost the Municipality 3.19 €/m^3 which is 268.06% more than the current cost of 1.19 €/m^3 for clean drinking water.

The residents of Hydra, as is now the case in many areas of Greece, covered their needs with poor quality and non-drinking water, which, on the one hand, destroyed household appliances and installations and, on the other hand, caused damage to its wider network island and settlements.

The daily routine of the residents was difficult, as they had to supply bottled water for drinking and cooking, had a high cost of repairing and replacing equipment, spent a lot of detergents, and scrubbed daily to clean taps and sanitary ware.

The corresponding problems faced daily by professionals were acting as a reversing factor for their actions, adversely affecting the economy of Hydra in general and the development of the tourism sector in particular.

It is also well known that the state and the municipalities in various regions of Greece- feed the brackish water networks from drilling. The pumping of water in this way, as well as its management, is expensive for public bodies, and it is even a half since it does not provide a definitive solution to the needs it needs to serve.

The negative consequences of this practice are the depletion of the stockpiles of the groundwater due to increase of salt concertation and continuous pumping, and the environmental burden of plastic bottles of bottled water and the consumption of water, excessive amounts of detergents.

It is noteworthy that for the completion of the so beneficial project in Hydra, the Municipality of Hydra and the wider Public Sector did not spend even one euro as the desalination plant was designed, licensed and implemented in an international competition by TEMAK which, in addition, it is responsible for providing drinking water by 2026.

In conclusion, installing a similar facility to all islands in Greece, such as the Municipality of Hydra, with the funding of the project mainly from the private sector, could potentially finally solve the serious issue of water scarcity.

In March 2019, TEMAK successfully launched the largest and most modern brackish water desalination plant in Greece, producing 10.000 cubic meters potable water per day.

TEMAK®
TOTAL WATER SOLUTIONS

WATER VALUE AMBASSADOR
• SINCE 1972 •

62, Tatoiou str., GR 136 77, Acharnes (Menidi), Athens, Greece
+30 210 2581 583 +30 210 2533 989 info@temak.gr www.temak.gr